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Antonio Navas-Ruiz. On Trade Openness, Institutional Change and Economic Growth. 2008. halshs-00326394

**HAL Id: halshs-00326394**

**<https://shs.hal.science/halshs-00326394>**

Preprint submitted on 2 Oct 2008

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# **GREQAM**

**Groupeement de Recherche en Economie  
Quantitative d'Aix-Marseille - UMR-CNRS 6579  
Ecole des Hautes Etudes en Sciences Sociales  
Universités d'Aix-Marseille II et III**

**Document de Travail  
n°2008-32**

## **ON TRADE OPENESS, INSTITUTIONAL CHANGE AND ECONOMIC GROWTH**

**Antonio NAVAS-RUIZ**

**September, 2007**



# On Trade Openness, Institutional Change and Economic Growth.

Antonio Navas-Ruiz\*

Universidad Carlos III de Madrid and GREQAM<sup>†</sup>

July 21, 2008

## Abstract

This paper explores the relationship between trade openness and economic growth through a change in institutions. To do so, the paper creates a theory of endogenous institutional change where there are three social groups, each one owns a specific production factor. An elite (landowners) controlling the political power fix higher taxes to extract rents from the other groups of the society (capitalists). This reduces investment in capital, the source for endogenous growth. Endogenous institutional change is done by allowing the rival group (capitalists) to invest in a military action which expels out the group in power. The model studies optimal taxation, growth and institutional change under two scenarios, autarky and free trade.

We calibrate the model according to Western European experience on the XVI<sup>th</sup> century deriving that: First: Economies opened to trade will experiment higher growth and faster institutional change. Second: Economies specializing in manufacturing products tend to grow more and rise the institutional change earlier. These results are very robust to change in parameter values and it seems to fit quite well with historical experience.

## 1 Introduction

Recent empirical evidence has pointed out the role played by institutions as one of the main determinants of the creation of technological progress, the traditional source of growth (Easterly and Levine, 2003). What the determinants of these institutions are and more precisely, what drives to some countries to build institutions boosting growth while some others create those ones that lead to stagnation has been subject of recent theoretical research (Acemoglu, Johnson and Robinson (2006)).

The aim of this paper is to study the implications of free trade to the emergence of growth-enhancing institutions. On the one hand, the paper contributes to the theory of the determinants of institutions

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\*I would like to thank Cecilia García Peñalosa, Omar Licandro, Gian Marco Ottaviano, Rubén Segura-Cayuela, Alain Gabler, and Carlos Ponce for useful comments and suggestions. I am totally indebted to Mar Cebrián and Joan Rosés for its comments on the historical part of the paper. I would like also to thank seminar participants at the GREQAM and participants at the RIEF (2007), EEA-ESEM 2008, for comments. Remaining errors are obviously mine.

<sup>†</sup>Contact details: Antonio Navas-Ruiz, Department of Economics, Universidad Carlos III de Madrid (on leave), e-mail (private): anavas1979@hotmail.com, Tfno: 91-624-58-96

by focusing on the role played by openness to international markets. On the other hand, it contributes to the theory of trade and growth by exploring a new channel through which trade can affect economic growth: the creation and promotion of institutions boosting growth.

To do so, we build a theory of endogenous growth with endogenous institutional change and we compare growth rates and the time for institutional change under two scenarios: one in which the economy is in autarky and another one when the economy opens to international trade. We consider only the case for small open economies.

The first step is to determine to what kind of institutions we are referring to and how they are established in a particular society. Institutions are a very broad concept and according to the definition of North and Thomas (1972), it englobes any kind of social or legal rule affecting the economic behaviour of individuals. Since our focus was on growth-enhancing institutions we are gonna restrict our attention to those having a strong impact on economic growth. There is a general agreement among growth theorists that the creation of a good system of property rights is by no means one of the fundamentals of economic growth (Knack and Keefer, (1997), Hall and Jones (1999), Acemoglu et al. (2001), De la Porta et al. (2004)). Therefore our attention is going to be focused on the emergence of this institution.

The next step is to consider a theory of how this system of property rights is determined in a particular society. Several approaches have been used to model the creation of institutions but we are going to take the one recently developed by Acemoglu (2005) since it is the one which seems to fit better with empirical facts. According to this theory there is a conflict of economic interests among different groups in a particular society which leads to different preferences for institutions. The established institutional system will be determined by the group in power, but other social groups could take military actions to expel out that group from the power and establish its own preferred institutional system.

Assuming that different sectors have different scopes of technological progress<sup>1</sup> the institutional system will maximize the growth rate of the economy, when the production possibilities of the group holding the political power are also the ones of the higher scope of learning. But, this could not be necessarily the case and this is the relevant case I am going to study <sup>2</sup> In that situation the current institutional system damages the interests of the social group promoting growth. The model itself provides a theory of endogenous institutional change where the accumulation of rents will allow the emerging class to conquer the power by investing some resources on military actions to expel out the group from the government. When this happens, the new political and institutional regime is established

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<sup>1</sup>In the seminal paper of Young (1991) this scope becomes endogenously determined. Young (1991) considers a model in which there is learning by doing in each sector but learning is decreasing with accumulative experience. When learning arise to an upper bound, improvements on this sector becomes zero. We can consider here that the learning in one sector is perfectly zero, for simplicity, but a situation in which the scope of learning in one sector is lower than in another sector will not alter qualitatively the results.

<sup>2</sup>In a great part of Western Europe, for example, in the middle and a great part of the modern age, the political power was mainly an oligarchy formed by those who enjoy landownership. However, the scope of technological progress in the agricultural sector was limited and subsequent technological improvements even in the agricultural sector were coming through the creation of capital goods.

with institutions benefitting the interests of the new group in power, whose interests goes hand in hand with economic growth. In this paper we study how this new institutional regime is achieved and particularly we focus on the role played by international trade.

The model presented here is a dynamic version of the Ricardo-Viner and Jones specific factor model with Learning by Doing in the manufacturing sector. Part of this accumulation of knowledge flows to the agricultural sector by means of technological spillovers. There are three social groups the Landowners, the Capitalists and the Workers. We study a situation in which the Landowners initially has the political power and constitutes the elite. They extract rents from the capitalists imposing a tax on the manufacturing sector (this tax should be understood as a proxy for some other related institutions, for example, expropriation etc...). This tax reduces capital accumulation and therefore growth. We introduce institutional change on the following way: Each period capitalists can finance, with a certain amount of capital a military intervention which expels out the Landowners establishing their own institutional system.

The benefits of the revolution in this model are proportional to the stock of capital per cápita of the capitalists. Under no revolution capitalists enjoy a lower interest rate because part of these rents are going to the Landowners. When the capitalists conquer the power they abolish this tax and therefore interest rates are higher. Since the gains are proportional to the capital stock we could derive a threshold level of capital such that above it individuals find always profitable to undertake the revolution.

International trade generates a redistribution of rents in the society that comes from the fact that production factors are remunerated differently in autarky than in free trade. These redistributive effects have different implications for institutional change. On the one hand, if the beneficiaries of a potential growth-boosting institutional change, are also the beneficiaries of the redistribution of rents generated by trade openness, that is in our case the Capitalists, the openness to trade could reduce the incentives to undertake the revolution because trade is already rising the income of this group being a potential substitute for the revolution. That is, because the rents of this group has risen under free trade, the difference between the rents of this group before and after the revolution could be lower. This is the standard effect found in models of institutional change described in Acemoglu, Johnson and Robinson (2006). However, because these models do not generally include dynamic effects they cannot account for a second but more important effect, if international trade changes the speed of accumulation of the rents of this social group, the threshold level of capital while higher could be risen earlier and institutional change will be executed quicker. The international trade pattern will ultimately determine both the redistribution of rents and the effects on the accumulation of rents, establishing the ultimate effect on institutional change.

Because the model do not have a closed form solution what I did is to calibrate the model according to the parameters suggested by Hansen and Prescott (2002) and some other historical studies for the case of the Western European Atlantic Trade on the XVI<sup>th</sup> century. Then I will compare the main predictions of the model to those found in the data to see whether the model is consistent with the

empirical evidence we have got for that period. Then I will also check whether these predictions hold for a wide range of parameter values.

This period is very well known by economic historians as the first era of world globalization. The discovery of America and new routes to trade with Asia increases world trade volumes on an annual rate of around 1%, around three times the average annual rate of growth for Europe (O'Rourke and Williamsom (2002)) However, among atlantic traders it is generally accepted that economies like Great Britain and the Netherlands, were introducing institutional changes during the XVII<sup>th</sup> and XVIII<sup>th</sup> centuries crucial to the first industrial revolution, while some other countries like Spain and Portugal, with a more rigid system and a smaller middle class did not generate this change<sup>3</sup>. To explain why Great Britain and the Netherlands did it and why Spain and Portugal did not, has been a challenge to economists and historians. In a very interesting paper, Acemoglu, Johnson and Robinson (2005) provides empirical evidence supporting the fact that the role played by international trade in the transition to modern growth of the western economies was non negligible. Moreover among those traders not all of them benefitted equally being England and the Netherlands those having higher benefits. The paper outline the role of initial political differences in the different experiences across Great Britain and the Netherlands and Spain and Portugal.

Our main results of the theoretical model state that: First, the disincentive effect is definitely less important than the growth effect, so that as long as international trade generates a higher growth rate, the institutional change will be given earlier. Secondly that international trade generates a positive growth effect that it comes through a general reduction on taxes or expropriation. This effect will imply that the general effect of trade on growth will be positive even if the economy specializes in agricultural goods, something quite different to the standard result of two sector models of trade and growth. Third, the effect on growth is larger when the economy specializes in manufacturing goods, so we should observe divergence between economies exposed to overseas trade according to the specialization pattern. These effects are qualitatively robust to changes in parameter values.

The implied predictions for the case studied are: Those economies participating in overseas trade should have grown more and given the institutional change earlier assuming similar initial political conditions. That it seems to fit quite well with the empirical studies carried out by Acemoglu, Johnson and Robinson (2005). Second, we should observe divergent growth and institutional experiences across atlantic traders based on specialization patterns: That it seems to fit as well with the empirical evidence. While economies like Great Britain and the Netherlands were specialized in exporting manufacturing

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<sup>3</sup>See for example, North and Thomas (1972), for an extensive survey on the different institutional environments introduced by the Dutch and the English from the XVI<sup>th</sup>. Cameron (1999) also provides a global perspective of the issue. Acemoglu, Johnson and Robinson (2003) provides a detailed survey of the different attempts to the elites established already in the power to avoid the introduction of such institutional arrangements.

For the case of Spain and Portugal, North and Thomas (1972) provides an extensive analysis. For the particular case of Spain see Yun (2002).

goods, economies like Spain or Portugal were engaged in trade mainly based on primary products, as wine, sherry, wool, oil, and metals like gold and silver in the first one, etc... (Wallerstein, 1974; Yun, 2002). Many references talked about a decline in the industrialists sectors for the spanish economy from XVI<sup>th</sup> century on , (Lynch (1991), Hamilton (1934), Alvarez and Prados (2007)). and the trasatlantic trade concentrated in the city of Seville was mainly based on the export of agricultural products and some manufacturing products. From the second half of the XVI<sup>th</sup> century, the role played by Spanish manufactures in the colonial trade was notably quite low and most of the manufactures exported to the colonies came from Great Britain, the Netherlands<sup>4</sup>.

Related theoretical literature has explored also the relationship between trade, institutions and growth but focusing on different historical episodes and different institutions. For example the work by Falkinger and Grossman (2005) have explored the effects of trade openness on policies promoting human capital accumulation in economies with different institutional settings. The interaction between factor endowments and the institutional setting will determine the effect that trade openness has on economic growth. Segura-Cayuela (2006) extends Acemoglu (2005) model to study whether property rights are determined differently under free trade and autarky across different political regimes and its consequences for output and welfare. According to this model in oligarchic societies openness to trade can reduce welfare by rising the incentives of the oligarchs to increase taxes. Although, his model omits capital accumulation and growth he focuses on the emergence of the same kind of institutions. Different from all of them our model rather than taking political institutions as given, it studies the consequences of openness to trade on the process of institutional change.

While it is true that we have focused in a particular historical period for simplicity, the implications of the model could be consistent with many other different historical episodes. Another interesting example can be found in the expansion of the agricultural trade of the Eastern European and Baltic economies during the XIV<sup>th</sup> and XV<sup>th</sup> centuries. In these countries the openness to international trade, rather than improving the conditions of the peasants and the merchant class, improved the conditions of the lords and the landowners, thereby delaying institutional change in these countries. The international trade pattern that these countries established with the economies of Western Europe was mainly based on the export of cereals, above all wheat, and the import of ellaborated products<sup>5</sup>. On the other hand it is generally accepted among historians, that feudalism was reinforced during the XVI<sup>th</sup> and XVII<sup>th</sup>

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<sup>4</sup>Many of them violated the state monopoly of the Casa de Contratacion by contracts with the spanish traders (Yun, 2002, Lynch (1991), Hamilton (1934) etc..). From the second half of the XVI<sup>th</sup> century Spain starts to import mainly textile manufactures, cotton manufactures, etc.. (Braudel, 1972). Shipping services had to be purchased from the Netherlands and Britain since the Spanish fleets, one of the most important industries at that time were insufficient. Others were passed through the Canary Islands which has an independent trade with America, by 1607.

<sup>5</sup>Hybel (2002) claims referring to the Netherlands: "Generations of historians have been of the opinion that from the mid-twelfth century the Netherlands maintained an industrial population that could not be fed from domestic agricultural production alone.[...] These regions became seriously dependent on grain supplies from the outside world , a development which brought about an increasing flow of grain from eastern to western Europe.

Later on when talking about the trade pattern corroborates that: "The bulk commodities from Scandinavia and the Baltic region were exchanged in western Europe for luxury products -in particular, cloth produced in the Netherlands and after 1300 increasingly in England. "

centuries in Eastern european economies. We believe that the international trade pattern beneficial to the feudal lords was crucial in the reinforcement of the existing regime during these centuries.

The baseline model of institutional change is developed in section 1. Section 2 extends the model to a small open economy and we study what are the conditions under institutional change is delayed or fostered. Section 3 concludes.

## 2 The Economy

### 2.1 Production

The model builds on a dynamic version of the Ricardo-Viner-Jones specific factor model with learning by doing à la Romer (1986) in the manufacturing sector. There are two sectors which uses specific factors of production but they compete for labor which is mobile across sectors. The technologies implemented in each sector are characterized by the following functional forms:

$$Y_t^A = T_t^\alpha (A_t L_t^A)^{1-\alpha} \quad (1)$$

$$Y_t^M = K_t^\alpha (B_t L_t^M)^{1-\alpha} \quad (2)$$

In this model the endogenous formation of technological progress by firm private decisions is not considered. Along the historical period of reference, private R&D investment was reasonably low, and advances of technology were mainly the result of accumulative experience. Therefore, it is reasonable to assume that advances in this economy comes from a learning by doing proccess. Following the standard specification of Romer (1986) I assume that this proccess was labor-augmenting and that part of this learning by doing was also transferred to the agricultural sector, therefore:

$$B_t = \theta K_t \quad (3)$$

$$A_t = \theta K_t^\phi, \quad 0 \leq \phi \leq 1.$$

, where  $\phi$  measures the degree of inter-sectorial technological spillovers and it is assumed to be at most one.

### 2.2 Consumption

Individuals in this economy, live for one period/generation and then die but capital accumulation is guaranteed by means of bequests to the future generation.<sup>6</sup> They are homogeneous in taste but

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<sup>6</sup>This kind of preferences are very used in the literature on income distribution and growth and very well known as Warmglowutility functions. The main implication of these preferences is that individuals derived utility from leaving bequests by itself (Joy of giving). In an outstanding paper Altonji, Hayashi and Kotlikoff (1997) provides empirical evidence supporting this kind of preferences. (more on historical evidence supporting this kind of preferences).



differ in the sources of income, the access to asset markets, and the initial endowment of political power. According to these characteristics we can identify three kind of agents: landowners, workers and capitalists. Population for each group is normalized to one for simplicity.

In this economy production factors are specific to individuals belonging to a particular social group. This means that access to the land is restricted to the landowners as long as access to capital goods are restricted to capitalists. There is a great consensus among economic historians and economist that this was the case for the preindustrial societies. Crouzet (1985) finds for example that for the case of the first industrial revolution, during the period (1750-1850) only 3% of the entrepreneurs were part of the upper class and less than 10% were descendants of landowning elites. In another interesting paper, Doepke and Zilibotti (2004) discuss about the tiny role played by the landowners elite and aristocracy in the early stages of the industrial revolution.

In the initial period, there is an equal distribution of land and land can be exchanged among landowners at the price of  $t_t$ . They can also explore the use of it contracting labor force and producing agricultural goods. We denote as  $d_t$  the rents per unit of land obtained from the production process. On the other hand, capitalists can explore also the use of capital by contracting labor force and producing manufacturing goods. We denote by  $r_t$  the rents per unit of capital obtained in the production process. Both landowners and capitalists can leave bequests by means of land and capital respectively to the future generation. The labor force is supplied by workers which do not have any access to either capital or land goods.

The way in which we are going to represent an imperfect system of property rights is by means of a tax. The group in power, that in this case it is the landowners, can take in ownership a part of the total output of the rival sector denoted by  $\tau_t$ . But different from conventional taxes these are gonna be decided at the beginning of the period, before the production and consumption decisions are made and they last for the whole generation of individuals<sup>7</sup>.

For simplicity, I am going to suppose Cobb-Douglas preferences for both final consumption goods, and in the case of the capitalists, also for the investment good. Landowners maximize:

$$\begin{aligned} \max_{c_{At}^A, c_{At}^M, T_{t+1}^i} \quad & \ln C_{At} + \ln T_{t+1}^i \\ \text{s.t.} \quad & C_{At} = (c_{At}^A)^\gamma (c_{At}^M)^{1-\gamma} \\ \text{s.t.} \quad & p_t c_{At}^A + c_{At}^M + t_t T_{t+1}^i = (t_t + d_t) T_t^i + \tau_t Y_t^M \end{aligned}$$

where,  $C_{At}$  is the total consumption index of the landowners,  $c_{At}^A, c_{At}^M$ , are both respectively the agricultural and the manufacturing consumption goods of the landowners and  $\gamma$  will be the proportion of expenditure dedicated to the agricultural good.

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<sup>7</sup>We do not allow for holdup problems in this model..

Each of the workers are endowed with one unit of labor. We denote with subscript  $L$ , the allocation referred to workers. They cannot leave heritage to future generations. They solve:

$$\begin{aligned} \max \ln C_{Lt} \\ s.t. C_{Lt} &= (c_{Lt}^A)^\gamma (c_{Lt}^M)^{1-\gamma} \\ p_t c_{Lt}^A + c_{Lt}^M &\leq w_t \end{aligned}$$

On the other hand, capitalists (denoted with subscript  $k$ ), can accumulate physical capital. We assume full depreciation of capital as Hansen and Prescott (2002)<sup>8</sup>. Capitalists solve the problem:

$$\begin{aligned} \max_{c_{At}^A, c_{At}^M, k_{t+1}} \ln C_{kt} + \ln K_{t+1} \\ s.t. C_{kt} &= (c_{kt}^A)^\gamma (c_{kt}^M)^{1-\gamma} \\ s.t. p_t c_{kt}^A + c_{kt}^M + K_{t+1} &\leq r_t K_t \end{aligned}$$

### 2.3 Solving the model

Solving the problem of consumers for each group give us the following demand functions for each consumption good:

$$c_{it}^A = \gamma \frac{E_{it}}{p_t}$$

$$c_{it}^M = (1 - \gamma) E_{it}$$

where  $E_{it}$ , is expenditure dedicated to consumption. Notice that for the workers we have that consumption expenditure is equal to income, but for the capitalists or the landowners, who they make investments too, we have that:

$$\begin{aligned} E_{kt} &= \frac{r_t K_t}{2} \\ E_{At} &= \frac{(t_t + d_t) T_t + \tau_t Y_t^M}{2} \\ K_{t+1} &= \frac{r_t K_t}{2} \\ T_{t+1}^i &= \frac{(t_t + d_t) T_t^i + \tau_t Y_t^M}{2t_t} \end{aligned} \tag{4}$$

and considering a case when there is no depreciation, we have that:

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<sup>8</sup>Due to the fact that the time that passes between one period and another in this model is equivalent to the life expectancy of a generation, which here we normalize to 70 years, the capital that it can remains from the previous generation to the future generation is negligible.

$$\frac{K_{t+1}}{K_t} = \frac{r_t}{2}.$$

Notice that the interest rate must be bigger than two. A similar condition is assumed in AK models, and given that a period it is a generation here, this value is rather plausible.<sup>9</sup> Calling  $C_t^j = \sum_{i=A,k,L} c_{it}^j$ ,  $j = A, M$ , we have that:

$$\frac{C_t^A}{C_t^M} = \frac{\gamma}{1-\gamma} \frac{1}{p_t}. \quad (5)$$

Landowners in the agricultural sector maximize:

$$\max_{L_t^A, T_t} p_t (T_t)^\alpha (A_t L_t^A)^{1-\alpha} - w_t L_t^A.$$

and given  $\tau$ , maximize:

$$\max_{L_t^M, K_t} (1-\tau_t) (K_t)^\alpha (B_t L_t^M)^{1-\alpha} - w_t L_t^M - r_t K_t$$

Assuming perfect competition and the fact that in equilibrium  $B$  and  $A$  are given by the expression above, rental prices for each factor under an interior solution are given by:

$$d_t = \alpha \theta^{1-\alpha} p_t (T_t)^{\alpha-1} (K_t)^{\phi(1-\alpha)} (L_t^A)^{1-\alpha} \quad (6)$$

$$w_t = (1-\alpha) p_t (T_t)^\alpha (K_t)^{\phi(1-\alpha)} (L_t^A)^{-\alpha} = (1-\alpha)(1-\tau_t) K_t (L_t^M)^{-\alpha} \quad (7)$$

$$r_t = \alpha \theta^{1-\alpha} (1-\tau_t) (L_t^M)^{1-\alpha} \quad (8)$$

To close the model we impose the market clearing conditions for labor and final consumption goods:

$$L_t^A + L_t^M = 1 \quad (9)$$

$$C_t^A = (T_t)^\alpha (K_t)^{\phi(1-\alpha)} (\theta L_t^A)^{1-\alpha} \quad (10)$$

$$C_t^M + K_{t+1} = K_t (\theta L_t^M)^{1-\alpha} \quad (11)$$

We assume that the total endowment of land is fixed over time, which implies that:

$$\sum_{i=1} T_{t+1}^i = T_t \quad (12)$$

Manipulating (5), (10), (11), (8), and (4) prices are given by:

$$p_t = \left( \frac{\gamma}{1-\gamma} \right) \left( \frac{(K_t)^{(1-\phi(1-\alpha))}}{(T_t)^\alpha} \right) \left( \frac{L_t^M}{L_t^A} \right)^{1-\alpha} \left( 1 - \frac{\alpha(1-\tau_t)}{2} \right) \quad (13)$$

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<sup>9</sup> AK models assume the condition  $r_t > \rho$ , for a positive growth rate which it means that the technology must be enough productive for the individuals to invest in capital accumulation. Later on we calibrate the model imposing the duration of the generation up to 70 years which implies an interest rate of 1%.

Taxes are going to affect optimal prices through two channels. Let denote the first channel as the demand channel, where the effect comes from the effect of taxes on the relative aggregate demand of agriculture and manufactured products. As you can see from (8) and (11) the rise in taxes reduces the demand of investment, reducing the relative demand of manufactured products and therefore rising the price of the agricultural goods  $p_t$  (Last element of equation (13)).

The second channel, denoted as the supply channel, comes from the effect of taxes in the optimal reallocation of workers across sectors. Because taxation reduces the marginal productivity of labor in the manufacturing sector, an increase in taxes shifts workers from the manufacturing sector to the agricultural sector. Going to the wage equation and using the market clearing condition for the labor market it can be got:

$$\frac{L_t^M}{L_t^A} = \left( \frac{1-\gamma}{\gamma} \right) \left( \frac{2(1-\tau_t)}{2-\alpha(1-\tau_t)} \right) \quad (14)$$

Notice that due to the assumption of Cobb-Douglas preferences, the allocation of labor across sectors do not depend on the endowments of the fixed factor. In a case with no taxes more labor is allocated to the manufacturing sector than to the agricultural sector because manufacturers produces also the investment good. However, taxes are shifting labor from manufacturing to agriculture. Using (9), it follows that:

$$L_t^A = \frac{(2-\alpha(1-\tau_t))\gamma}{(2-(2+\alpha)\gamma)(1-\tau_t)+2\gamma} \quad (15)$$

$$L_t^M = \frac{2(1-\tau_t)(1-\gamma)}{(2-(2+\alpha)\gamma)(1-\tau_t)+2\gamma} \quad (16)$$

therefore, an increase in taxes, will increase labor in the agricultural sector, increasing the supply and reducing the relative price  $p_t$ .

This latter effect can be seen substituting the equation (13) for the expression of the optimal labor allocation across sector, (equation (14)):

$$p_t = \left( \left( \frac{\gamma}{1-\gamma} \right)^\alpha \left( \frac{(K_t)^{(1-\phi(1-\alpha))}}{(T_t)^\alpha} \right) \left( \frac{2-\alpha(1-\tau_t)}{2} \right)^\alpha (1-\tau_t)^{1-\alpha} \right) \quad (17)$$

Taking derivatives, it can be shown that it is monotonically decreasing in taxes for a low value of  $\alpha$ .

**Proposition 1**  $\frac{dp_t}{d\tau} < 0$ , if  $\alpha < \frac{2}{3-\tau_t}$ .

The sign of the derivative depends on the relative strength of both effects, the supply and the demand one. Looking at condition (13) it can be noticed that for the extreme cases  $\alpha = 0, \alpha = 1$ , the effect is negative and positive respectively. When  $\alpha$  is low, the effect in the supply side, is very strong as it can be seen in the second element of condition (13) while the effect in the demand side, the third term in the same equation is very small given as a consequence, a decrease in the relative price of the agricultural good (an increase in the relative price of the manufacturing good). Notice that, the rank of possible

limits for  $\alpha$  are  $\alpha \in (\frac{2}{3}, 1)$ . Since no empirical evidence has reported such a high value for  $\alpha$  even in recent times we can consider the derivative to be negative. The law of motion of capital is given by:

$$\frac{K_{t+1}}{K_t} = \frac{\alpha\theta(1-\tau_t)(L_t^M)^{1-\alpha}}{2} = \frac{\alpha\theta(1-\tau_t)\left(\frac{2(1-\tau_t)}{(2-\alpha)(1-\tau_t)+2}\right)^{1-\alpha}}{2} \quad (18)$$

Since all the landowners are identical in preferences and endowments, in equilibrium the distribution of land across landowners will not be altered and the prices of the land are given by the expression:

$$t_t = \frac{d_t T_t + \tau_t Y_t^M}{T_t}$$

which is just the rents that each landowner receives for using the land in the agricultural sector and the political rents associated with the land ownership.

Total output in nominal terms is given by:

$$Y_t = p_t \theta T_t (L_t^A)^{1-\alpha} + \theta K_t (L_t^M)^{1-\alpha}. \quad (19)$$

Looking at condition (18) it can be seen that the level of  $\tau_t$  is crucial in the dynamics of the model. Because taxes are creating a distortion in both production and consumption, the tax rate that maximizes aggregate output is  $\tau = 0$ .<sup>10</sup> The next section explains how the tax rate  $\tau$ , is determined.

## 2.4 The political system and the level of $\tau_t$

In this section we are going to discuss how  $\tau_t$  is determined.

Substituting the optimality conditions and rearranging terms we have that the indirect utility function is given by:

$$V_t^A = \ln \left( \frac{I_t^A}{(p_t)^\gamma} \right)$$

where for the case of the capitalists is given by:

$$V_t^k = \ln \left( \frac{I_t^k}{(p_t)^\gamma} \right)$$

where  $I_t^A, I_t^k$ , are the respective income of the landowners and capitalists.

**Proposition 2** *Let  $V_t^k$  be the indirect utility function of the capitalists. Then:*

$$\frac{dV_t^k}{d\tau} < 0$$

**Proof.** *The result is straightforward taking derivatives with respect to  $\tau_t$  in capitalists income and rearranging terms. See appendix. ■*

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<sup>10</sup> Although the agents are not maximizing output given the positive externality derived from the LBD assumption, this kind of taxonomy will not help to overcome the externality, and what's more it gets it worst because an increase in taxes diverts resources from investment to consumption. Therefore the tax rate maximizing output is zero.

Taxes reduces nominal income through a reduction in the interest rate reducing capitalists indirect utility function but taxes reduces the price of the agricultural good having a positive effect in the capitalists indirect utility function. However, the income effect is stronger than the substitution effect and the net effect is negative.

Substituting the value of  $I_t^A$  given by the budget constraint of the landowners we have that:

$$V_t^A = \zeta' + \ln \left( \alpha \theta (p_t)^{1-\gamma} (L_t^A)^{1-\alpha} (T_t)^\alpha (K_t)^{\phi(1-\alpha)} + \tau_t \theta (p_t)^{-\gamma} K_t (L_t^M)^{1-\alpha} \right) \quad (20)$$

where  $\zeta'$  is a constant from the point of view of taxation. Notice that this expression is ambiguous in the level of taxes  $\tau_t$ . Taxes here affects the utility of landowners through three mechanisms. The first and the second one are already very well known in the literature. The first one is called, Revenue extraction and it is the direct impact of a rise in taxes on fiscal income which ceteris paribus is positive. The second one is called factor price manipulation: An increase in taxes, increases the amount of labor in the agricultural sector, due to a reduction in the marginal productivity of labor in the manufacturing sector. The elites therefore has the incentive to rise taxes in order to attract labor into the agricultural sector, rising the rents from the land. However, by reducing the mass of workers in the manufacturing sector, fiscal income decreases and the net effect is not clear.

The third one is the effect on the relative price. Changes in the relative price will have a direct effect on income and utility (i.e.: An increase in taxes, decreases the price of the agricultural good, reducing the nominal rents of the land but rising the indirect utility) and an indirect effect through changes in the reallocation of labor across activities (i.e. The rise in taxes, decreases prices, decreasing the value of the marginal productivity of labor in the agricultural sector and rising labor in the manufacturing sector). As you can see from equation (20) either the net direct effect or the net indirect effect of taxes through this channel on landowners indirect utility is ambiguous. This is not usually present in the literature because these models treats the two consumption good as perfect substitutes for simplification.

However notice that it is precisely through changes in relative prices that international trade will change the optimal tax chosen by the landowners having consequences for growth. When the economy opens to trade, prices will be determined by the rest of the world (a small open economy is going to be considered). This implies that landowners cannot affect prices when deciding about taxes having two important consequences: On the one hand, landowners cannot rise the value of fiscal income by putting higher taxes which decrease prices. On the other hand, landowners cannot manipulate taxes to affect labor allocation across sectors.

Using the expression for prices (13) and making several rearrangements you can get the expression:

$$V_t^A = \ln \left( \alpha \left( \frac{\gamma}{1-\gamma} \right) \left( \frac{2-\alpha(1-\tau_t)}{2} \right)^{(1-\gamma)} + \tau \left( \frac{2}{2-\alpha(1-\tau_t)} \right)^{-\gamma} \right) + \ln \left( (L_t^M)^{(1-\alpha)(1-\gamma)} (L_t^A)^{\gamma(1-\alpha)} \right)$$

which after manipulating, substituting (15), (16) and subtracting the constant terms, the expression remains:

$$V_t^A = Ln \left( \left( \frac{(1 - \tau_t)^{(1-\alpha)(1-\gamma)}}{(2 - \alpha(1 - \tau_t))^{\alpha\gamma}} \right) \left( \frac{\alpha(2 - \alpha(1 - \tau_t))\gamma + 2\tau_t(1 - \gamma)}{((2 + \alpha)\gamma - \alpha)(1 - \tau_t) + 2(1 - \gamma))^{1-\alpha}} \right) \right)$$

The appendix solves for the optimal tax rate and it shows that it is interior and unique for the numerical example considered below. Given that it was not possible to find an analytical expression for the value of  $\tau$ , a numerical solution was carried out. Hansen and Prescott (2002) uses the value of  $\alpha = 0.4$ , for simulating a similar model in which the manufacturing sector uses the same technology, so we will take also that but we make robust check with different levels of  $\alpha$ . For the parameter  $\gamma$  we have taken the value of 0.7 suggested on the new database on european consumption baskets built by Peter H. Lindert<sup>11</sup>. For calibrating the technological constant  $\theta$ , I take the Maddison's estimate for the average per capita GDP growth rate for the Western Europe of 0.14% per year. Because in this model each period is considered as a generation I will use the Hansen and Prescott (2002) value for a duration of generation that is 70 years<sup>12</sup>. The following table gives gross growth rates per year under no taxes (what it would be the economy after institutional change), under optimal taxes (what it would be the economy before institutional change), and labor allocations for this numerical example:

<i>regime</i>	$\tau$	<i>Lmtaxes</i>	<i>Lataxes</i>	<i>rtaxes</i>	<i>gtaxes</i>
<i>taxes</i>	0.7709	0.0933	0.9067	1.0113	1.0013
<i>notaxes</i>	0	0.3488	0.6512	1.0445	1.0342

**Proposition 3**  $\tau^* = \max V_t^F(\tau) \neq 0, 1$ , and it is independent of  $K_t, T$ . and unique for the parameter case studied

**Proof.** See appendix. ■

Notice that the optimal tax is quite high. Population in each activity under a situation of autarky and taxation, is given by 9% where 91% is dedicated to agriculture. Using the share of population living in medium sized cities, as a proxy for the share of the labor force dedicated to the manufacturing sector reveals that the results of the model are not too far from real data. The share of population living in cities with more than 5000 individuals in the XVI<sup>th</sup>, according to Maddison (2005) for England is around 16% very similar to the 9% per cent given by the model. The second row of the table presents the prediction of the model under a situation of no struggling institutions. We can see that in fact bad institutions are making the economy to grow 3 percentual points less per year.

## 2.5 How the Capitalists can reach the power

Capitalists can rise to power by investing  $m$  units of the capital stock in order to finance an army which gets the monopoly of military strength in the state. We use capital stock units because at the

<sup>11</sup>This database is collecting data on budgets of individuals belonging to different social classes and in different countries across different periods of time. Data reports differences by social groups and by countries although these differences are not very big, but all of the estimations, suggest a value for  $\gamma$  between 0.6 and 0.8.

<sup>12</sup>Qualitative results are not affected by the duration of a period although this will have important consequences in the quantitative results.

beginning of the period, when this choice is made, the only asset individuals have to invest is the stock of capital they inherit from the past generation. The parameter  $m$  will be interpreted as different initial political conditions, (i.e. military force strength, size etc.). Economies with strong state conditions (huge requirements of military force) could need more time for a revolution and a change in the political power, because the cost is higher. On the other hand a reasonable assumption is going to be made: capitalists cannot borrow for making this investment.

Two conditions are needed to have a revolution in this economy: firstly, it must be profitable and secondly it can be financed. Mathematically means that:

$$V_t^k(\tau = 0, I_t^k = r_t(k_t - m)) - V_t^k(\tau = \tau_t^*, I_t^k = r_t^* k_t) \geq 0$$

$$k_t^{*k} \geq m$$

The first condition is easy to derive:

$$\ln \left( \frac{r_t(k_t^k - m)}{r_t^* k_t^k} \right) \left( \frac{(p_t^*)^\gamma}{(p_t)^\gamma} \right) \geq 0$$

which implies:

$$k_t \geq k^* = \frac{mr\lambda}{r\lambda - r^*} \quad (21)$$

where:

$$\lambda = \left( \frac{p_t^*}{p_t} \right)^\gamma = \left( (1 - \tau^*)^{1-\alpha} \left( \frac{2 - \alpha(1 - \tau^*)}{2 - \alpha} \right)^\alpha \right)^\gamma$$

Condition (21) just tell us that the benefits of the revolution must be higher than the cost. The cost is given by  $m$  units of capital, which can be used in the production process to obtain  $mr$  units of manufacturing goods. To translated into utils we need to divide by the price index of the economy which is given by:  $(p_t)^\gamma (1)^{1-\gamma} = (p_t)^\gamma$ . On the other hand, we have the benefits, which are given by the difference in rates of returns between a situation with no taxes and with taxes. The parameter  $\lambda$  corrects for the differential in prices under both situations.

When we remove taxes there is, on the one hand an increase in the interest rate, which increases capitalists income. These benefits are proportional to the stock of capital that each individual has; on the other hand there is a rise in the price of the agricultural good, what it decreases capitalists real rents. From previous analysis we have derived that the latter cannot overcome the first effect and therefore capitalists are better off with lower taxes.

There is a threshold level of capital stock that would make the revolution profitable. This is just the consequence of having the gains proportional to the individual capital stock. Interesting is to see that



the larger the interest rate in autarky, the larger the threshold level of capital. This is very similar to that found in Acemoglu (2006). The larger the interest rate in autarky the lower the gains from the revolt because the difference between the interest rate before and after the institutional change is smaller. Therefore, the more capital you need to have to compensate the revolution investment. Notice also that the larger/ the smaller the price of the agricultural goods the more/the less costly is to undertake the revolution.

Taking into account the two constraints it is important to realize that the first one is redundant unless the revolution is not profitable at all (*i.e.*,  $r\lambda > r^*$ ). In order to have an institutional change the following condition must hold:

$$k_t \geq k^* = \mu m.$$

$$\mu = \frac{1}{1 - \frac{r^*}{r} \lambda^{-1}}$$

One of the may drawbacks of this experiment and mainly of the whole literature when carrying these models to the data, is the fact that it is difficult to give a value to the cost of the revolution  $m$ . Main results do not depend on the parameter  $m$  at least qualitatively. For comparative purposes let us denote  $n$  as the number of years that it takes to arrive to  $k^*$ . This is given by:

$$n = \frac{\ln \mu}{\ln(1+g)} + \frac{\ln(m/k_t)}{\ln(1+g)} \quad (22)$$

## 2.6 Steady state

The assumption of Cobb-Douglas preferences it allows us to define a BGP when all variables grows at a constant rate. In concrete, under this assumption our model is a version of a standard two sector AK model except from the fact that when the institutional change is done there will be a jump in the growth rate, that is: first the economy will grow at the constant growth rate  $g_1$ . Capitalists will accumulate more and more capital up to they are able to get the political power. When  $k_t = k^*$ , the revolution arrive, the elites are removed from the power and as a consequence the capitalists will set the tax rate to zero. There will be a jump to a new steady state when the growth rate will be definitely higher and equal to  $g_2$ . A mathematical proof of these statements is given in the following proposition:.

**Definition 4** *A BGP for this economy is a situation where the variables,  $L_t^M, L_t^A, \tau_t$ , are constant and the variables  $C_t^A, C_t^M, p_t, d_t, w_t$ , grows at a constant rate.*

**Proposition 5** *A BGP for this economy exists and it is unique.*

**Proof.** From the maximization problem of the indirect utility function of the farmers it is easy to see that  $\tau$  is interior and constant, since the value function only depend on constant parameters.

Looking at  $L_t^M, L_t^A$ , it is easy to see that the allocation of workers across sectors is also constant because only depends on  $\tau, \alpha$ .

Substituting (13) in (19):

$$Y = \left( \frac{\gamma(2-\alpha(1-\tau)+2(1-\gamma))}{2(1-\gamma)} \right) (L_t^M)^{1-\alpha} K = DK$$

which as standard in AK models is linear in capital stock. The same properties of a two-sector AK model then applies and let denote  $\frac{Y_{t+1}}{Y_t} = \frac{K_{t+1}}{K_t} = g$ .

Looking at (10) it can be noticed that production  $\frac{C_{t+1}^A}{C_t^A} = \frac{Y_{t+1}^A}{Y_t^A} = \phi(1-\alpha)g$  is also constant, and substituting (4), (8), in (11), it can be seen that  $\frac{C_{t+1}^M}{C_t^M} = \frac{Y_{t+1}^M}{Y_t^M} = g$  constant.

Since  $p_t = \vartheta K_t^{1-\phi(1-\alpha)}$  you can get that it grows at  $(1-\phi(1-\alpha))g$ , and  $d_t, w_t$  are a linear function of  $p_t, K_t^{\phi(1-\alpha)}$  and another constant variables, therefore both of them are also growing at the same constant rate  $g$ .

When the constraint  $k_t \leq k^*$  holds, the growth rate of the economy is given by  $g = g_1 = \frac{\alpha\theta(1-\tau^*)(L_t^M)^{1-\alpha}}{2}$ . Because  $k^*$ , does not depend on capital, and  $\frac{K_{t+1}}{K_t} = g$  grows constantly, then  $k^*$  will be risen at a finite time.

When  $k \geq k^*, \tau = 0$ , in steady state and the growth rate of the economy is given by  $g = \alpha \left( \theta \left( \frac{2(1-\gamma)}{2-\alpha\gamma} \right) \right)^{1-\alpha}$  where the condition,  $\theta > \left( \frac{1}{\alpha} \right)^{\frac{1}{1-\alpha}} \left( \frac{2-\alpha\gamma}{2(1-\gamma)} \right)$  is needed to have a positive growth rate (this condition is similar to the condition  $r > \rho$ , standard in the AK models. ) ■

### 3 Small open economy

Let consider now the case of a small open economy which opens to trade and the equilibrium price of the rest of the world is given by  $p_t^*$ . Consumer decisions will not be altered with trade openness. Firms keep on allocating labour sources according to the following condition:

$$\frac{L_t^A}{L_t^M} = \left( \frac{p_t^* \bar{T}^\alpha}{(1-\tau_t) K_t^{(1-\phi(1-\alpha))}} \right)^{\frac{1}{\alpha}} \quad (23)$$

where the price now is given by the above definition and therefore exogenous. Notice that when the price for the agricultural good rises, the economy switches resources from the manufacturing into the agricultural sector. Landowners fix taxes according to the new economic equilibrium. Manipulating (26) and the market clearing condition for labor and substituting in the utility function of the landowners it remains:

$$V_t^A = \zeta' + Ln \left( \alpha\theta (p_t^*)^{1-\gamma} (L_t^A)^{1-\alpha} K_t^{\phi(1-\alpha)} T_t + \tau_t \theta (p_t^*)^{-\gamma} K_t (L_t^M)^{1-\alpha} \right)$$

where now prices are given by  $p_t^*$  and therefore exogenous in the model.

One of the nice properties of assuming the Cobb-Douglas production function was that labor allocations and therefore taxes do not depend on factor endowments and therefore they were constant along time. Prices were doing the work. In some sense this property is lost when analysing the case of a small open economy. Prices are exogenous and therefore do not depend on national factor endowments any more. This has the uncomfortable property that now taxes at each point in time depends on the capital

stock. Taxes, labor allocations, and the growth rate of the economy changes over time making difficult to provide conclusions about the transition. Taking the first order conditions for taxes, the dynamics of the system, can be characterized by a system of two difference equations given by:

$$(p_t^* T^\alpha)^{\frac{1}{\alpha}} [(1 + \alpha)\tau_t + \alpha^2(1 - \tau_t) - 2\alpha] = \alpha(1 - \tau_t)^{\frac{1+\alpha}{\alpha}} \left( K_t^{(1-\phi(1-\alpha))} \right)^{\frac{1}{\alpha}} \quad (24)$$

$$\frac{K_{t+1}}{K_t} = \left( \frac{\alpha\theta(1 - \tau_t)^{\frac{1}{\alpha}}}{2} \right) \left( \frac{\left( K_t^{(1-\phi(1-\alpha))} \right)^{\frac{1}{\alpha}}}{(p_t^* T)^{\frac{1}{\alpha}} + \left( (1 - \tau_t) K_t^{(1-\phi(1-\alpha))} \right)^{\frac{1}{\alpha}}} \right)^{1-\alpha} \quad (25)$$

The following proposition reports interesting properties with respect to the optimal tax,  $\tau^*$ .

**Proposition 6**  $\tau^*$  is interior, monotonically increasing with  $K_t$ , and monotonically decreasing with  $p_t^*$ .

**Proof.** See Appendix. ■

Notice that whenever prices decrease or physical capital increases, labor allocation in the manufacturing sector increases, and also the value of fiscal income in real terms increases, increasing marginal income coming from taxation and rising the incentives to put higher taxes. In that case, the economy starts to specialize in manufacturing, landowners observe a general rise in the returns to capital and they try to tax more the capitalists.

Given that taxes generally depend on capital stock at each point in time the model does not present a constant BGP through the period we study. To reestablish constant BGP and therefore make the model a little bit more tractable, we are gonna assume that the price of the rest of the world moves according to: .

$$\frac{\dot{p}_t^*}{p_t^*} = (1 - \phi(1 - \alpha)) \frac{\dot{K}_t}{K_t}$$

Notice that from (26- 25) it can be seen that taxes, the growth rate of capital stock and labor allocations are constant. This special case is studied in the following section.

### 3.1 A special case

Let consider now the previous case when the price for the rest of the world is given by  $p_t^* = \delta q_t$ , where  $q_t$  will be the autarkic price at the time of openness  $t$ . Defining  $q_t = \eta \frac{K_t}{T^\alpha}^{1-\phi(1-\alpha)}$ , where  $\eta = \left( \frac{\gamma}{1-\gamma} \right)^\alpha \left( \frac{2-\alpha(1-\tau^*)}{2} \right)^\alpha (1 - \tau^*)^{1-\alpha}$ , and  $\tau^*$  is the value of the optimal tax in the autarkic case. Intersectorial labor market allocation is given by:

$$\frac{L_t^A}{L_t^M} = \left( \frac{\delta \eta}{1 - \tau} \right)^{\frac{1}{\alpha}} \quad (26)$$

which turns out to be independent of the capital stock again and to be constant along time. Notice, however that intersectorial labor allocation depends now on  $\delta$ . When  $\delta = 1$ , prices do not change and

labor market allocations will be equal if  $\tau = \tau^*$ . When the economy opens to trade if  $\delta$  is bigger than one (as a consequence of trade the price of the agricultural good rises up), there is a shift of labour from the manufacturing sector to the agricultural one. As a consequence our economy will produce more agricultural goods and less manufacturing products. The reversed case will occur if  $\delta$  is less than one. To derive taxes and the law of movement of capital stock we come back to the system previously derived but with the new expression for prices:

$$(\delta\eta)^{\frac{1}{\alpha}} [(1+\alpha)\tau_t + \alpha^2(1-\tau_t) - 2\alpha] = \alpha(1-\tau_t)^{\frac{1+\alpha}{\alpha}} \quad (27)$$

$$\frac{K_{t+1}}{K_t} = \left( \frac{\alpha\theta(1-\tau_t)^{\frac{1}{\alpha}}}{2} \right) \left( \frac{1}{(\delta\eta)^{\frac{1}{\alpha}} + ((1-\tau_t))^{\frac{1}{\alpha}}} \right)^{1-\alpha} \quad (28)$$

Intersectorial labor allocation and taxes depend only on  $\delta, \gamma$  and  $\alpha$ . We are going to focus on the analysis of the economy before the institutional change has been carried out, where as we have commented before, for the special case of this section, the dynamic properties of the model are equal to the case in autarky. As in the previous section we carried out a numerical exercise for the value of  $\alpha = 0.4$  and  $\gamma = 0.7$ , allowing for different values of  $\delta$ . The table below shows the value for taxes and the rest of the variables as a function of  $\delta$ .

$\delta$	0.2	0.4	0.6	0.8	1	2	2.5
$\tau$	0.7966	0.7029	0.6401	0.6053	0.5797	0.5325	0.5259
$L_t^M$	0.8104	0.6608	0.5265	0.4119	0.3193	0.0977	0.0603
$r$	1.0284	1.0323	1.0329	1.0322	1.0309	1.0220	1.018
$g$	1.0183	1.0220	1.0227	1.0220	1.0207	1.0120	1.008

Looking at the table we can see that depending on the specialization pattern of the economy, trade will have different effects on the growth rate of the economy. First of all it is worthy to mention that as a consequence of the openness to trade in a small open economy the landowners fix lower taxes. As commented before when the economy opens to trade the landowners no longer are able to affect output prices. Since an increase in taxes in autarky was pushing down prices increasing fiscal income in nominal and in real terms, landowners had incentives to put higher taxes. Openness to trade reduces the incentives to tax higher because real fiscal income no longer will increase with taxes. When trade prices have not changed ( $\delta = 1$ ) but landowners consider they cannot manipulate prices any more, they fix taxes almost 20% lower than before.

However, when the price is not equal to the one in autarky we have important reallocation effects in the labor market which will have important effects on growth through both the direct effect of the reallocation of labor and the indirect effect on taxes. As we have derived in the previous section whenever the price  $p_t$  falls, or the economy specializes in manufacturing goods, labor in the manufacturing sector increases due to a rise in the real price of manufacturing goods. However, the fall in prices rises marginal income coming from taxation what it will increase taxes. This reduces labor in the manufacturing sector. The final effect on labor, the interest rate and growth is ambiguous then for that case. On the one hand,

taxes are higher but on the other hand the value of the marginal productivity of the manufacturing sector is also higher.

An interesting result is that the effect on reallocation of labor dominates but only up to a certain point when it is the rise in taxes the effect that dominates. That is, in this model, a higher degree of specialization in manufacturing not always implies a higher growth rate although it is always superior than the one in autarky.

For the case of the specialization in agriculture things are different. Taxes will fall as landowners want to push investment since this will imply larger fiscal income. However the rise in agricultural prices rises wages depressing the labor allocation to the manufacturing sector. The latter effect cannot overcome the first one so that the net effect is negative.

## 4 The effects on institutional change.

Two effects can be perfectly distinguished on the time for the institutional change. On the one hand, international trade eliminates any link between agricultural prices and taxes. In autarky, eliminating taxes was having a cost since lower taxes implies higher prices. Under free trade eliminating taxes will not have any effect on prices, so trade eliminates this cost. On the other hand, international trade by reducing taxes rises the growth rate of output through an increase in the interest rate. This has an ambiguous effect on institutional change: the higher the growth rate of output, the easier is to rise the threshold level of capital stock to give the revolution, but as commented before, the larger the interest rate the lower the gains from the revolution and therefore, the less profitable is to do it.

This can be easily seen in equation (22). Notice that since price without taxes are larger than with taxes (Prop.2) then  $\lambda < 1$ . With free trade  $\lambda = 1$ , so, this reduces  $\mu$ . On the other hand, we know that  $r^*$  increases so this increases  $\mu$ . The effects on  $n$  are therefore ambiguous because the increase in  $g$  reduces  $m$  but the increase in  $\mu$  increases  $n$ .

Since  $(1 + g') > (1 + g)$ , in order to show that  $n' < n$ , we need just to show that  $\frac{Ln\phi'}{Ln(1+g')} < \frac{Ln\phi}{Ln(1+g)}$ .

What we have found is that this is always satisfied in our numerical example. This can be observed in the following table:

$\delta$	0.2	0.4	0.6	0.8	1	2	2.5
$a^f$	10.95	12.31	12.94	13.16	9.9440	12.66	25.45
$b^f$	55.24	45.95	44.51	45.95	43.104	83.83	125.45

where the term  $a^f = \frac{Ln\mu'}{Ln(1+g')}$ , and the term  $b^f = \frac{1}{Ln(1+g')}$ . The autarkic values for  $a$  and  $b$  are 194.75 and 769.73 respectively. Notice that the difference between those values in autarky and in free trade are very big. This is due to the fact that the effect that trade has on the growth rate is quite high what it accelerates the process. In concrete the values for the constant  $\phi'$  are higher than the one for

$\phi$  but the acceleration in the growth rate makes the "a's" to be smaller. Notice that the fact that the time for institutional change is shorten in every economy is independent of the institutional change cost  $m$ . However in assesing quantitative predictions for the time of the institutional change, we should give values for the parameter  $m$ .

Since it is the effect in the growth rate the dominant effect, all conclusions relative to specialization pattern discussed before applies also to the institutional change argument, that is: specializing in manufacturing goods, rises the growth rate, accelerating output and the time for the institutional change. As before the degree of specialization matters. For high changes in relative prices, the growth rate could fall desaccelerating output and delaying the time for the institutional change.

Trade will have always positive effects on the time for the institutional change because the effects of the tax reduction on the growth rate. But paralell to the effects on growth, the specialization pattern matters for the institutional change. That is, *ceteris paribus*, economies specializing in agricultural goods will always give the institutional change later on time. Therefore this theory outlines the importance of trade patterns and specialization on the creation of a good system of property rights. In this economy, differences on trade patterns across countries create divergent growth and institutional experiences across countries.

These qualitative results seems to be very robust to changes in parameter values. In order to verify this, we have carried out several experiments. First we have let  $\gamma$  vary for a fixed value of  $\alpha$ , and we have carried out the experiment for two values of  $\alpha$  (since the standard values for this parameter are between 0.3 and 0.4) . Secondly we have fixed  $\gamma$  but we have let  $\alpha$  to vary and we have carried out the experiment for two values of  $\gamma$ . In all the experiments carried out the results keep in qualitative terms.

While the predictions of the model seems to be right in qualitative terms, the empirical evidence however shows that our results overstate the impact of trade. First of all, taking Maddison (2001) estimates for the growth rates for the western economies all over the period (1500-1820) turns out to be 0.80 and 0.56 for England and the Netherlands, and 0.51, 0.31 for the case of Portugal and Spain respectively. About the amount of trade empirical evidence suggest that it was not so big during this period (O'Rourke and Williamsom, 2001) so this would imply that price movements were not so big, so we will be in the cases described when  $\delta$  should be closed to one. While the share of labor in each sector seems to be consistent with the evidence, the effect in the growth rate seems to be overstated. At the end of the XVIII th century, the share of population working on industry or services in The Netherlands was around 60%. If we consider that by that time the institutional change in these economies have been already made, this implies that our share of labor dedicated to manufacturing is extremely high. Only similar results to those that we derive would be possible for the UK at the end of the XIX<sup>th</sup> century.

## 4.1 Decentralization

One of the main reasons why these large growth effects appear in the previous exercise is given by the fact that taxes are very high in autarky, so that opening to trade has a fall in taxes by 20%. This

falling in taxes comes from the fact that landowners know that they can reduce prices and increase fiscal income in real terms, when choosing taxes so in autarky, they choose a higher tax in order to get lower prices.

What I did in this section is to consider that landowners do not consider the effect of taxes on prices. A way of motivating this could be for example decentralization. If we have a continuum of equally endowed landowners each of them with a power to extract rents only on their own manor then, the effect that their own tax will have on the determination of the relative prices of the agricultural good will be negligible so that they can ignore it. Notice that there would be still general equilibrium price effects of taxes, but these are not taken into account when making the tax decision.

This is equivalent to the problem solved in the small open economy case but taking into account that the price  $p_t$  is given by the labor and the final goods market clearing conditions and therefore affected by taxes and given by the expression 17. The optimal tax comes from the following condition:

$$[(1 + \alpha)\tau_t + \alpha^2(1 - \tau_t) - 2\alpha] = \frac{\alpha\gamma}{1 - \gamma} \left( \frac{2(1 - \tau_t)}{2 - \alpha(1 - \tau_t)} \right) (1 - \tau_t)$$

which can be easily seen that satisfies the conditions for the uniqueness of the solution in  $\tau$ . The solution for autarky:

<i>regime</i>	$\tau$	<i>Lmtaxes</i>	<i>Lataxes</i>	<i>rtaxes</i>	<i>gtaxes</i>
<i>taxes</i>	0.6284	0.1468	0.8532	1.0113	1.0013
<i>notaxes</i>	0	0.3488	0.6512	1.0445	1.0342

The value for  $a$  in autarky is 382.75. The value for  $b$  obviously does not change since it only depends on the growth rate of output.

When we open to trade results are given by the following table:

$\delta$	0.2	0.4	0.6	0.8	1	1.2	1.5
$\tau$	0.7611	0.6621	0.6065	0.5742	0.5549	0.5431	0.5328
$L_t^M$	0.7612	0.5727	0.4159	0.2970	0.2127	0.1546	0.0996
$r$	1.0192	1.0217	1.0212	1.0194	1.0171	1.0147	1.0112
$g$	1.0091	1.0117	1.0111	1.0093	1.0071	1.0047	1.0012

Notice that there is still a reduction in taxes when we open to trade, but in this case it is really very small. This is the consequence of the fact that in autarky taxes reduce agricultural prices rising labor in the manufacturing sector and increasing marginal income of taxation. Openness to trade reduces the incentives to put higher taxes because marginal income coming from taxation reduces as prices are no longer affected by taxes. However, although important, this effect is relatively small. can be seen again in the column where  $\delta = 1$ , so the autarkic price and the price under trade openness is exactly equal.

The results are very similar in qualitative terms, since in fact what we have eliminated is a general reduction in taxes that comes from the general equilibrium price effect<sup>13</sup>. However, these results change a lot in quantitative terms and as you can see the share of labor in the manufacturing sector and the estimations of the growth rates seems to fit quite well with the data previously commented. The results for the institutional change are pretty similar and reported in the appendix.

## 5 Conclusions

We have set up a simple model in order to understand the role played by international trade on economic growth through the evolution of the institutional environment. In a society in which the political power is at the hands of a social group whose interests are in conflict with economic growth, like for example the aristocracy in Europe in the modern age, this social group will establish an institutional environment which is bad for growth. This group, however, establishes institutions which do not lead to full expropriation of the other social groups since full expropriation would lead to no investment and no fiscal rents. The process of capital accumulation along time will allow the rival group to conquer the political power, and to create growth-boosting institutional system.

In this context we want to examine the role played by international trade. We have considered the case of a small open economy where the equilibrium prices are taken as given and equilibrium variables are not affected by the individual decisions. We have discovered that international trade plays a role in the evolution of the institutional environment both, by changing the way production factors are remunerated according to comparative advantage, what changes the return on capital, accumulation and growth and through general equilibrium price effects. If trade specialization pattern rises capital rents, then capital accumulation becomes faster, accelerating the process of institutional change. An interesting result is that due to the independence of prices to local conditions under free trade, the elite fixes lower taxes, what it allows the country to grow more even if the country specializes in agricultural goods. This goes against standard two sector endogenous growth models. However, the growth rate will be lower than if the economy specializes in manufacturing.

We suggest that a similar story could be in the heart of the divergent experience of Spain and Portugal on the one hand, and England and The Netherlands on the other hand when they were opened to trade with the Americas. While Spain and Portugal were specializing in trade in raw materials in the global world, reinforcing the economic and political power of the aristocracy, english and dutch manufacturers and merchants were improving their economic position by exporting manufactured goods having earlier experiences of social and political revolutions. Our model will predict that trade will enhance institutional change in the four countries provided that the movement in relative prices was not very high, but England and the Netherlands, should experiment higher growth and earlier institutional change.

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<sup>13</sup> Although not reported the main difference in qualitative terms underlies on the fact that for high enough prices of the agricultural good, the growth rate in free trade is lower than in autarky. That is now, not always free trade has positive effects on growth but still for a very big rank of prices that is the case.



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## 7 Appendix A Taxes in autarky

**Proof.**  $\frac{dV_t^k}{d\tau_t} < 0$ .

Developing the expression of the indirect utility function we have:

$$V_t^k = \left( \frac{2}{(2 - \alpha(1 - \tau_t))} \right)^\gamma (\alpha\theta(1 - \tau_t)) (L_t^M)^{(1-\gamma)(1-\alpha)} (L_t^A)^{\gamma(1-\alpha)}$$

Using (14), manipulating and rearranging terms we arrive to:

$$V_t^k = \left( \frac{L_t^M}{L_t^A} \right)^\gamma (\alpha(1 - \tau_t)) (L_t^M)^{(1-\gamma)(1-\alpha)} (L_t^A)^{\gamma(1-\alpha)}$$

and operating we arrive to:

$$V_t^k = \alpha(1 - \tau_t) (L_t^M)^{(1-\alpha(1-\gamma))} (L_t^A)^{-\alpha\gamma}$$

Then it is easy to see that the derivative of the indirect utility function with respect to taxes is equal to zero, since  $\frac{dL_t^M}{d\tau_t} < 0$ ,  $\frac{dL_t^A}{d\tau_t} > 0$ . ■

**Proposition 7 Proof.** Taking derivatives and rearranging terms we arrive to the f.o.c.:

$$f = (1 - \alpha) \left( \frac{2 - (2 + \alpha)\gamma}{((2 - (2 + \alpha)\gamma)(1 - \tau) + 2\gamma)} - \frac{1 - \gamma}{(1 - \tau)} \right) - \frac{\alpha^2 \gamma}{(2 - \alpha(1 - \tau))} + \frac{\alpha^2 \gamma + 2(1 - \gamma)}{\alpha(2 - \alpha(1 - \tau)\gamma) + 2\tau(1 - \gamma)} = 0$$

This condition:

it goes to  $-\infty$  when  $\tau = 1$ , and it is positive when  $\tau = 0$ . Moreover this function is continuous in  $\tau \in (0, 1)$ . The intermediate value theorem therefore says that there is an interior  $\tau$ , on the interval  $(0, 1)$  such that:  $f = 0$ .

Uniqueness is shown, first by multiplying  $f$  for  $(1 - \tau)$  and for simplicity we make a change of variables calling  $x = (1 - \tau)$

Then we have:

$$A - B + C = 0$$

where

$$A = (1 - \alpha) \left( \frac{(2 - \alpha)x}{(2 - \alpha)x + 2} - \frac{1}{2} \right)$$

$$B = \frac{\alpha^2(1 - \alpha)x}{2(2 - \alpha x)}$$

$$C = \frac{(\alpha^2 + 2)(1 - \alpha)x}{2(1 + \alpha) - (2 + \alpha^2)x}$$

and notice that  $C$  and  $B$  are monotone in  $x$ . By taking derivatives in  $A$  with respect to  $x$ :

$$\frac{dA}{dx} = \frac{2(1 - \alpha)(2 - \alpha)}{((2 - \alpha)x + 2)^2} > 0$$

and given that  $A, B, C$ , are continuous on the interval  $\tau \in (0, 1)$ , then the proof reduces to show that :

$$A - B + C > 0,$$

It can be shown algebraically that this is the case for  $\alpha = 0.4$ . A general solution for all values of  $\alpha$ , remains to be shown. ■

## 8 Appendix B Taxes in small open economy

**Proof.** Substituting in the indirect utility function for the optimal values of labor  $L_t^A, L_t^M$ , and rearranging terms we have that:

$$V_t^A = \ln \left( \frac{\alpha (p_t^*)^{\frac{2-\alpha}{2\alpha}} T_t + \tau_t (p_t^*)^{\frac{-1}{2}} K_t (1 - \tau_t)^{\frac{1-\alpha}{\alpha}}}{\left( (p_t^*)^{\frac{1}{\alpha}} T + (1 - \tau_t)^{\frac{1}{\alpha}} K_t \right)^{1-\alpha}} \right)$$

Rearranging terms in the first order condition for  $\tau_t$  we get:

$$f(\tau_t^*) = (1 - \tau_t^*)^{\frac{1-\alpha}{\alpha}} K_t \left( \frac{\left(1 - \left(\frac{1-\alpha}{\alpha}\right) \left(\frac{\tau_t^*}{1-\tau_t^*}\right)\right) (p_t^*)^{\frac{-1}{2}}}{\alpha (p_t^*)^{\frac{2-\alpha}{2\alpha}} T_t + \tau_t (p_t^*)^{\frac{-1}{2}} K_t (1 - \tau_t^*)^{\frac{1-\alpha}{\alpha}}} \right) - \frac{(1 - \tau_t^*)^{\frac{1-\alpha}{\alpha}} K_t \left(\frac{1-\alpha}{\alpha}\right)}{\left((p_t^*)^{\frac{1}{\alpha}} T + (1 - \tau_t^*)^{\frac{1}{\alpha}} K_t\right)^{1-\alpha}} = 0$$

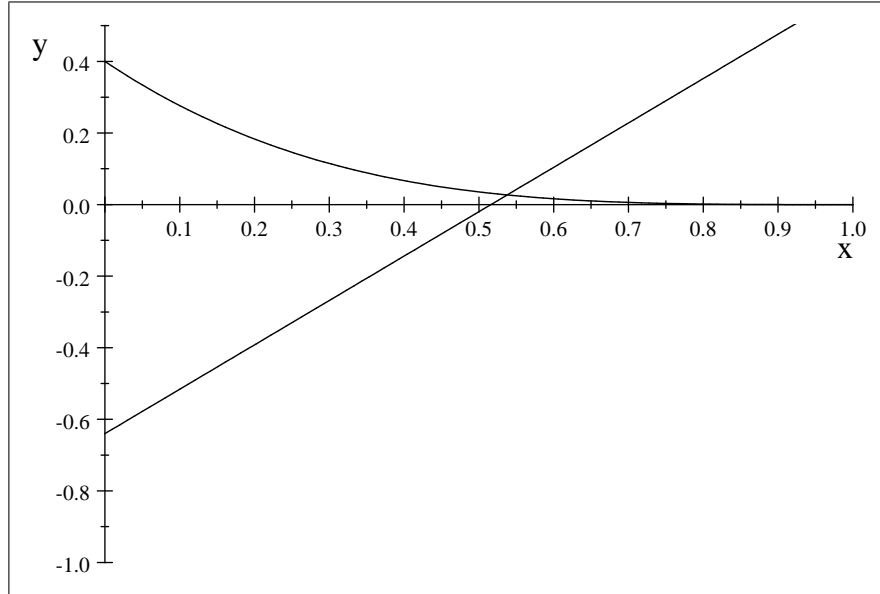
Notice that  $V_t^A$  is continuous on the interval  $\tau_t \in [0, 1]$ , and the first order condition is positive when  $\tau = 0$ , and  $\lim_{\tau \rightarrow 1} f(\tau_t^*) < 0$ , implying that  $\tau_t$  must be interior.

Working on  $f(\tau_t^*)$  we arrive to the following expression:

$$(p_t^* T)^{\frac{1}{\alpha}} [(1 + \alpha)\tau_t + \alpha^2(1 - \tau) - 2\alpha] = \alpha (1 - \tau)^{\frac{1+\alpha}{\alpha}} (K_t)^{\frac{1}{\alpha}}$$

where uniqueness is obtained directly applying the intermediate value theorem.

A graph illustrating the two curves is provided below.



Notice that increases in capital stock shifts right hand side into the right rising taxes.

Notice that increases in prices rotates left hand side into the right reducing taxes. The same applies for a rise in the endowment of land.

Q.E.D. ■

## 9 Appendix 3: Robustness

First  $\alpha = 0.4$  but  $\gamma$  varies:

$\gamma$	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8
$\tau^*$	0.83	0.8	0.78	0.774	0.769	0.768	0.77	0.776
$a$	120.15	147.23	163.48	174.9	183.45	189.95	194.75	197.96
$b$	769.7307							
$\tau^f$	0.772	0.711	0.672	0.643	0.619	0.5989	0.5797	0.5608
$a^f$	26.8	25.9	23.68	21.05	18.47	15.89	13.49	11.08
$b^f$	122.45	98.53	83.83	72.44	63.39	55.44	48.8	42.69

Second  $\gamma = 0.7$ ,  $\alpha$  varies.

$\alpha$	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8
$\tau^*$	0.7925	0.7776	0.7704	0.7709	0.779	0.796	0.822	0.861
$a$	224.46	224.24	213.32	194.75	170.91	143.35	112.87	79.53
$b$	769.7307							
$\tau^f$	0.5845	0.5539	0.5397	0.5797	0.638	0.7026	0.7682	0.8363
$a^f$	23.17	27.96	35.34	48.80	69.46	103.50	149.75	233.05
$b^f$	12.28	12.47	12.66	13.49	15.71	19.39	23.76	28.36

Simulation for the decentralized case

$\delta$	0.2	0.4	0.6	0.8	1	1.2	1.5
$a^f$	25.16	24.61	26.18	29.41	35.71	50.28	181.27
$b^f$	110.38	85.96	90.58	108.02	141.3	213.26	833.83